DESCRIPTIONS...

MICROGRAVITY ANALOGS

NASA uses free-fall environments to do many types of experiments because free-fall allows other forces to dominate. Forces like surface tension and diffusion are present in a, 1g [point down] environment, but gravity's effect is so overwhelming that their impact often goes unnoticed.

Methods that are used to gain the effects of free-fall and microgravity include:
- drop towers,
- parabolic flight,
- sounding rockets,
- spaceflight,
- bed rest,
- and bioreactors.

DROP TOWERS

Drop towers are described just as they sound except that they are not usually built up, they are built down into the ground. Drop towers allow freefall environments for about 2-5 seconds.

If you would like to build your own drop tower, or microgravity demonstrator, you can find directions right here at http://www.ncmr.org/education/k12/material.html. You can also learn about a competition for high school students held at Glenn Research Center. It is called DIME or Dropping in a Microgravity Environment and more information is found here http://microgravity.grc.nasa.gov/DIME.html.

PARABOLIC FLIGHT

Have you ever gone over the top of hill on a roller coaster and felt like you were coming out of your seat? Going up over that hill or parabola is something NASA imitates on a much larger scale with aircraft.

Parabolic flight is done with an aircraft called the KC-135. The KC-135 is an aircraft with an open cabin allowing for freedom of movement. This plane goes up and down similar to a roller coaster and as the passengers go over the top of the "hill," they are given 20-25 seconds of freefall. The missions are about 2-3 hours long and they do about 30-40 maneuvers. It's easy to understand why this plane is also known as the "Vomit Comet."

College students can compete to perform their own experiments on this weightless wonder in the Reduced Gravity Student Flight Opportunities Program at Johnson Space Center. You can find out more information at http://microgravityuniversity.jsc.nasa.gov

SOUNDING ROCKETS

Sounding rockets launch their experiments or payloads to altitudes of 800 miles which allows for a free-fall of the experiment for 4-12 minutes.

There is also a competition for high school students to launch their own experiments, on sounding rockets. Through the NASA Student Involvement Program, or NSIP, students in grades 9-12 compete to test their own microgravity ideas at the NASA Wallops Flight Facility in Virginia. Find information about how to compete in this experiment or enter other competitions for grades K-12 at http://www.nsip.net.

BED REST

However, the main drawback to spaceflight is that it is very high demand and is only available for a limited number of experiments. One way to perform more of the research on humans is to create a similar analog or analogy to the lack of loading in Space. Have you ever been sick in bed for a few days or more? When you are able to get up you just feel so weak from not using your muscles. Scientists are currently doing bed rest studies where participants, well… rest in bed for months at a time. They are allowed to get up for exercising, just as the astronauts, but otherwise, they must "take a load off" as it were.

BIOREACTORS

NASA engineers were tasked with developing a method of creating long-term freefall conditions for cell culture in a cost effective, highly repeatable manner.

In the early 1990's, the rotating bioreactor was created. The bioreactor rotates the cells and the culture medium in a way that makes the fluid move as one body. The cells are kept in suspension, not centrifuged, so that they tumble. The direction of gravity's force on the cells changes constantly and randomly. This allows the three-dimensional freedom desired for cell growth.

Although it does not provide all of the beneficial effects in cell culturing as found in spaceflight, the bioreactor provides an excellent model and more similar results to what is found on orbit. Using the bioreactor, numerous types of cancer cells and healthy cells have been cultured to study their growth and the effect that microgravity has on them.

Scientists were astounded when prostate cancer cells, grown on Shuttle mission STS-107, formed a tumor large enough to fill the container. Where as on Earth, the same type of cells grew in much smaller tumors.